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FOR

Distributed Ad Flight Management

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10 BACKGROUND OF THE INVENTION

1. Field of the Invention

15 The present invention relates to the field of data processing. More specifically, the present invention relates to the art of managing presentation of advertisements to online users.

2. Background Information

20 With the advent of public data networks, such as the Internet, and content servers, such as the World Wide Web (WWW), technologies associated with presenting advertisements to online users have become of great interest to many artesian. The general core technology for presenting advertisements to online users is known in the art. See for examples, U.S. Patents 5,740,540, 5,838,790, 5,948,061 and 6,119,098. However, none had adequately addressed the issue of "flight management".

25 In presenting advertisements, it is well known that in order to maximize the effectiveness of an advertising campaign, advertisers would often desire to have the presentations "spread out" over an extended campaign period, as opposed to having the presentations be made in a "burst", over a narrow time period. Further, as opposed to a straight linear rate over the campaign period, advertisers often desire
30 the presentations be made in accordance with certain non-linear profiles, also known as flight profiles (**Fig. 3a & 3b**).

5 However, because content servers such as web servers of the WWW often have to service millions of users, it is important for the content servers to be very efficient and responsive in serving user requests. Thus, it is undesirable to burden the content servers to make a lot of real time complex decisions to manage advertisement presentation. Moreover, it is generally desirable for content servers
10 to be architected in a scalable manner, i.e. not requiring client devices to be tightly coupled to the content servers before client devices may enjoy the services or benefits offered the content servers.

 Accordingly, an approach to managing advertisement presentations (in accordance with desired flight profiles) that is efficient and scalable is desired.

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SUMMARY OF THE INVENTION

 In accordance with the present invention, an advertisement server makes an
20 initial selection and provision of a number of advertisements for a number of client devices for presentation in accordance with corresponding desired flight profiles to be achieved for the advertisements. The provisions include one or more presentation parameters to govern the rates in which the provided advertisements are to be presented. The client devices selectively present the advertisements in
25 accordance with the governing presentation parameters. Further, the client devices report their presentations. The advertisement server in turn repeats the selection and provision of advertisements further taking into consideration the reports.

 In one embodiment, the advertisement server makes the advertisement selections probabilistically. In one embodiment, the selection is made via at least
30 two stages, with the first stage establishing a candidate pool of advertisements. Further, the advertisement server employs in the second stage, a set of weights

5 commensurate with the residual presentations of the advertisements to be made to
achieve the corresponding desired flight profiles when making the probabilistic
selections. The advertisement server periodically re-determines the weights based
on aggregated presentations made (as reported by the client devices). In one
embodiment, a minimum and a maximum presentation parameter are employed as
10 the governing presentation parameters for each advertisement, which are
determined in accordance with the desired flight profile of the advertisement, and the
point in time in the flight.

In one embodiment, the advertisements are selected and provided to the
client devices in response to their requests, which are explicitly made periodically to
15 ensure an ample supply of eligible advertisements are available in the corresponding
local caches. In one embodiment, the requests are also deemed to have been
made per online content searches performed by the client devices.

In one embodiment, the advertisement server includes a number of
transaction engines to select and provide the advertisements, and accept
20 presentation reports from the client devices, a logging service to aggregate the
presentations reported, and a manager to periodically re-determine the selection
parameters employed in the selection process.

In one embodiment, the advertisement server is implemented using a
“collection” of one or more data processing servers.

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BRIEF DESCRIPTION OF DRAWINGS

The present invention will be described by way of exemplary embodiments,
30 but not limitations, illustrated in the accompanying drawings in which like references
denote similar elements, and in which:

5 **Figures 1 and 2a-2b** illustrate a network view and two method views of the distributed advertising management system of the present invention, in accordance with one embodiment;

Figures 3a-3b illustrate a total impression view and delivery rate view of a number of example advertisement flight profiles;

10 **Figure 4** illustrates the advertisement database of **Fig. 1**, in accordance with one embodiment;

Figure 5 illustrates the operational flow of the relevant aspects of the advertisement manager of **Fig. 1**, in accordance with one embodiment;

Figures 6-7 illustrate the operational flow of the relevant aspects of the transaction engines of **Fig. 1**, in accordance with one embodiment;

Figure 8 illustrates the operational flow of the relevant aspects of the logging services of **Fig. 1**, in accordance with one embodiment;

Figure 9 illustrates the local advertisement cache of **Fig. 1**, in accordance with one embodiment;

20 **Figure 10** illustrates a queue structure employed by the advertisement management extension of **Fig. 1**, in accordance with one embodiment;

Figure 11 illustrates the operational flow of the relevant aspects of the advertisement management extension of **Fig. 1**, in accordance with one embodiment; and

25 **Figure 12** illustrates a computer system suitable for use as either a client or a server to practice the present invention, in accordance with one embodiment.

DETAILED DESCRIPTION OF THE INVENTION

5 In the following description, various aspects of the present invention will be described. However, it will be apparent to those skilled in the art that the present invention may be practiced with only some or all aspects of the present invention. For purposes of explanation, specific numbers, materials and configurations are set forth in order to provide a thorough understanding of the present invention. However, it will
10 also be apparent to one skilled in the art that the present invention may be practiced without the specific details. In other instances, well known features are omitted or simplified in order not to obscure the present invention.

Parts of the description will be presented in terms of operations performed by a processor based device, using terms such as data, tables, selecting, transmitting,
15 displaying, and the like, consistent with the manner commonly employed by those skilled in the art to convey the substance of their work to others skilled in the art. As well understood by those skilled in the art, the quantities take the form of electrical, magnetic, or optical signals capable of being stored, transferred, combined, and otherwise manipulated through mechanical and electrical components of the
20 processor based device; and the term processor include microprocessors, micro-controllers, digital signal processors, and the like, that are standalone, adjunct or embedded.

Various operations will be described as multiple discrete steps in turn, in a manner that is most helpful in understanding the present invention, however, the
25 order of description should not be construed as to imply that these operations are necessarily order dependent. In particular, these operations need not be performed in the order of presentation. Further, the description repeatedly uses the phrase "in one embodiment", which ordinarily does not refer to the same embodiment, although it may.

Referring now first to **Figures 1** and **2a-2b**, wherein three diagrams illustrating a network view and two method views of the distributed advertising management system the present invention, in accordance with one embodiment, are shown. As illustrated in **Fig. 1**, an advertisement server **112** is equipped with the teachings of the present invention to manage advertisement presentation to online users of client devices **102**, in accordance with corresponding desired flight profiles of the advertisements. Client devices **102** may be executing various online applications, including e.g. accessing content servers **112**. In one embodiment, the types of advertisements provided are customized in accordance with the demographics of the users of client devices **102** and/or the subject matters of the online contents. Subject matters may be indicated by keywords and/or topic categories. Client devices **102**, ad server **112** and content sites **110** are all coupled to each other through networking fabric **124**.

As illustrated in **Fig 2a**, at start of operation, ad server **112** would make an initial selection and provision of a number of advertisements for a number of client devices **102** for presentation in accordance with corresponding desired flight profiles to be achieved for the advertisements (block **202**). The provisions would include one or more presentation parameters to govern the rates in which the provided advertisements are to be presented by client devices **102**. Client devices **102** in turn would selectively present the advertisements in accordance with the governing presentation parameters (block **204**). Further, client devices **102** would report their presentations back to ad server **112**. Ad server **112** in turn would repeat the selections and provisions of advertisements, further taking into consideration the presentations reported (block **206**). The process continues iteratively, and in due course, presentation of the advertisements in accordance with the corresponding desired flight profiles is achieved.

Referring back to **Figure 1**, for the illustrated embodiment, ad server **112** is constituted with a number of transaction engines **114**, logging service **116**, manager **120**, and database **118**. Database **118** is employed to store various associated information of the advertisements to be presented, including operational data. Of particular interest are data that describe the locations where the advertisements may be retrieved, the desired flight profiles of the advertisements to be presented, and the actual presentations or impressions served.

As will be described in more detail below, transaction engines **114** are employed to interact with client devices **102**, probabilistically selecting and providing client devices **102** with advertisements for presentation, in accordance with at least the desired flight profiles of the advertisements, employing a number of selection parameters. In one embodiment, as alluded to earlier, the types of advertisements selected are customized in view of the demographics of the users of client devices **102**, and/or subject matters of the online searches being conducted by the users of client devices **102**. Included with the advertisements provided to client devices **102** are presentation parameters governing at least the rates the advertisements may be presented by client devices **102**. Transaction engines **114** further accept reports of presentations of the provided advertisements from client devices **102**, and periodically transfer the reported presentation data to logging service **116** for aggregation.

Logging service **116** periodically accepts transfers of the presentation reports from transaction engines **114**. In response, logging service **116** aggregates the reported presentations. Manager **120** in turn periodically uses the aggregated presentations and the corresponding flight profiles, and re-determines the selection parameters to be employed by transaction engines **114** for making the earlier described selections and provisions of advertisements to client devices **120** for presentation.

5 Over on the client side, client devices **102** are equipped with enhanced generic user agents, such as browsers **104**, each enhanced with an advertising management extension **106**. Advertising management extension **106** is designed to cooperate with ad server **112** to facilitate advertisement presentations in accordance with the present invention. More specifically, among the various functions performed

10 by advertisement management extension **106** is the function for requesting ad server **112** to pre-provide its host client device **102** with a number of advertisements. In one embodiment, advertisement management extension **106** is implemented as additional COM objects of the browser ("container"). For the illustrated embodiment, for efficiency of operation, each of client devices **102** also includes a local cache **108**

15 for storing at least the control information of the "provided" advertisements. For the illustrated embodiment, local cache **108** is also used to cache the "provided" advertisements. [In another embodiment, the advertisements themselves are not actually provided. Only control information (which includes the location of the actual advertisements) are provided and cached. The advertisements themselves are

20 retrieved from the identified locations at playtime and cached automatically by the browser into the standard html page cache.]

Further, some of browsers **104** may also each additionally enhanced with a meta search extension for conducting meta searches directly from client devices **102** (without having operational dependency on prior art meta search servers, such as

25 Alta Vistas and the like). For some of these embodiments, either advertisement management extension **106** or the meta search extension may inform ad server **112** of the subject matters of the online searches being conducted by the users of client devices **102**, thereby enabling these subject matters to influence the advertisements being selected for presentation. In some embodiments, the manner in which the

30 subject matters are taken into account is by treating a notice of a search request as a request for additional provision of advertisements. Client based meta search is the

5 subject matter of co-pending application, entitled "Client Based Meta Search", filed on 12/06/00, application no. 09/731,890, which is hereby fully incorporated by reference.

The interactions between enhanced browsers **104** of client devices **102** and transaction engines **114** of ad server **112** are advantageously architected in a scalable manner such that any one of transaction engines **114** may service anyone of client devices **102** (at the direction of a load balancer (not shown)). In fact, a client device **102** may be serviced by different transaction engines **114** for different transactions during the same online session. Transaction engines **114**, logging services **116** and manager **120** are all "loosely" coupled to each other.

15 **Fig. 2b** illustrates the method of the present invention in further details, in accordance with one embodiment. As illustrated, the method of the present invention begins at block **222** with manager **120** determining an initial set of weights for transaction engines **114** to probabilistically select and provide advertisements for client devices **102**, in accordance with the flight profiles of the advertisements.

20 Then, transaction engines **114** probabilistically select the advertisements for presentation using the current weights, block **224**. Transaction engines **114** also determine and include a number of presentation parameters governing the rates of presentations of the provided advertisements by client devices **102**, block **226**. In one embodiment, the governing parameters include a minimum and a maximum number of presentations for each advertisement, denoting the minimum and maximum number of presentations to be made for an advertisement by a receiving client device.

25 Thereafter, client devices **102** select and present the advertisements to their users, in accordance with the included governing presentation parameters, block **228**. The local selections and presentations are made without requiring further

5 interactions or interventions by ad server **112**. Client devices **102**, in real time or in batch, report the presentations to ad server **112**, block **230**.

Logging service **116** periodically aggregates the reported presentations. Also periodically, manager **120** re-determines the weights to be employed by transaction engines **114** in the selections and provisions of advertisements to client devices **102**,
10 further taking into consideration the reported presentations, block **232**.

Thus, the present invention advantageously enables advertisements to be presented to users of client devices **102** in accordance with the corresponding flight profiles desired by the advertisers, but without requiring complex advertisement management decisions to be made in real time (by transaction engines **112**) to
15 effectuate the desired flight control, and ad server **112** is highly scalable, allowing more or less transaction engines **114** to be deployed.

Referring back to **Fig. 1**, in one embodiment, one or more data processing servers are employed to implement ad server **112**. Except for the advertisement teachings of the present invention, client devices **102**, the implementing data
20 processing servers of ad server **112**, the constituting elements of network fabrics **124** as well as content sites **110** are all intended to represent a broad range of these elements known in the art. The implementing data processing servers may be any one of a number of such servers available from e.g. Sun Microsystems of Menlo Park, CA, or IBM of Armonk, NY. The client devices may be computing devices of
25 any one of a number of form factors, including but are not limited, palm sized, notebook sized, or desktop computers, such as those available from Hewlett Packard of Palo Alto, CA, as well as set top devices. Browsers **104**, except for advertising manager extension **106**, may be any one of a number of browsers known in the art, including but are not limited to Internet Explorer, available from Microsoft,
30 Inc., of Redmond, WA. Similarly, the constituting elements of networking fabrics may be any one of a number of networking routing, switching or elements of the like

known in the art, including but are not limited to such devices available from Cisco Systems of San Jose, CA, or Juniper Systems of Sunnyvale, CA. Thus, except for transaction engines **114**, logging service **116**, manager **120**, and advertisement management extension **106**, the remaining elements illustrated in **Fig. 1**, will not be further described.

Database

As described earlier, database **118** of ad server **112** is used to store the associated information of the advertisements to be presented, including in particular the locations where the advertisements may be retrieved. The manner in which advertisements are distributively stored is unimportant to the practice of the present invention. The advertisements may be stored using any one of a number of data organizations known in the art. [In alternate embodiments, some or all of the advertisements to be presented may be centrally stored on ad server **112** instead.]

Figure 4 illustrates a data structure suitable for use to store the more essential advertisement associated information for practice the present invention. As illustrated, for the embodiment, database **118** includes table/view **400** having a number of columns, in particular, column **402** for storing identifiers of the advertisements, column **403** for storing the URLs of the advertisements, columns **406** for storing data describing the flight profiles, such as the starting and ending dates of the campaign or profile, the desired number of impressions, and the desired rate/profile the impressions are to be presented, and columns **408** for storing data reflecting the aggregated reported presentations of the advertisements. Of course, this embodiment can also be considered as a view onto a more complex relation between multiple tables.

Moreover, for the embodiment, table/view **400** further includes column **404** for storing a number of selection criteria. As described earlier, in some embodiments,

the selection of advertisements are further customized in accordance with the demographics of the users of client devices **102**, and/or subject matters of online searches being conducted by the users of client devices **102**. For these embodiments, the selection criteria may include demographic information of the target groups of the advertisements, such as age, sex, and so forth, as well as subject matter information such as, books, records, videos, and so forth.

Database **118** may be implemented using anyone of a number of database management systems known in the art, including but are not limited to Oracle, available from Oracle Corp., of Redwood Shore, CA, or DB2, available from IBM Corp., of Armonk, NY.

Determining Selection Weights

Recall from earlier description that in one embodiment, transaction engines **114** probabilistically select and provide advertisements for client devices **102**. More specifically, manager **120** determines the selection weights to be employed by transaction engines **114** in performing the probabilistic selections.

Figure 5 illustrates a process for determining the selection weights of the advertisements, in accordance with one embodiment. As described earlier, manager **120**, determines the selection weights of the advertisements periodically. Initially, manager **120** determines the selection weights of the advertisements in view of the desired flight profiles. In subsequent determinations, manager **120** further makes the determination in view of the reported presentations.

As illustrated in **Figure 5**, for the embodiment, during each determination, manager **120** determines the selection weights for the advertisements, one advertisement at a time. At block **502**, manager **120** selects an advertisement for analysis. Next, at block **504**, manager **120** retrieves the desired flight profile and the actual impressions presented thus far for the selected advertisement. (Naturally, the

5 actual impressions presented thus far for the initial determination is zero.) Upon retrieving the desired flight profile and the actual impressions presented thus far, manager 120 determines the selection weight for the advertisement using the retrieved information, block 506.

In one embodiment, manager 120 determines the selection weight as follows:

- 10 1) If it is an initial assignment, manager 120 assigns an initial weight based on the average rate of impressions to be presented for the advertisement. In one embodiment, the initial weight is a weight between 1 – 255, depending on how the average rate of impressions to be presented for the advertisement compares to the global average rate of impressions to be presented for all advertisements.
- 15 2) If it is a subsequent (post initial) determination, manager 120 determines an adjustment to the weight to bring the actual impressions in line with the desired impressions at a given moment in time, and adjusts the weight accordingly. The adjustment is determined using the formula
- 20
$$\nabla W = C_1 \frac{(I_d - I_a)}{I_d} + C_2 \frac{(S_d - S_a)}{S_d}, \text{ where}$$
- a. ∇W is the change in weight being calculated,
 - b. C_1 and C_2 are empirically determined constants (which vary from embodiment to embodiment depending on the number of clients, their behaviors, and the number of advertisements services, as the initial weights),
 - c. I_d is the desired number of impressions (determined based on the flight profile associated with the advertisement),
 - d. I_a is the actual number of impressions presented thus far for the advertisement,
- 25

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e. S_a is the rate at which the advertisement has been served since the last weight calculation period (S_a can be calculated using the equation $S_a = \frac{(I_{a1} - I_{a0})}{t_1 - t_0}$, where I_{a1} is the total impressions for this advertisement now, I_{a0} is the total impressions for this advertisement at the previous calculation period, t_1 is the time now, and t_0 is the time of the previous calculation period),

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f. S_d is the desired delivery rate of advertisement for the immediate future (which may be one or more re-calculation periods) according to the flight profile,

The equation employed is made up of two components: $\frac{(I_d - I_a)}{I_d}$ and $\frac{(S_d - S_a)}{S_d}$. The first component gives the ratio of the difference

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between desired and actual impressions-to-date, and the desired impressions-to-date. Thus, the value of this component will be 0 when the desired and actual values are the same, negative when the actual value is too high, and positive when the actual value is too low. The second component gives the ratio of the difference between the desired rate of delivery in the immediate future and the actual rate of delivery in the immediate past, and the desired rate of delivery in the immediate future. This adds a damping effect to the adjustment algorithm. For example, if the impressions-to-date values (both actual and desired) are the same, meaning $\frac{(I_d - I_a)}{I_d} = 0$, but actual

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impressions are being delivered faster than desired, the weight is decreased in an effort to bring the delivery rates in sync, and thus keep the actual impressions-to-date from being greater than the desired value at the next adjustment.

5 In alternate embodiments, other initial weight ranges or other initial weight assignment approaches may also be employed. Preferably, the initial weight assignment approach should reflect the number of clients, their access behaviors, and the typical number of advertisements being serviced for a particular implementation. The exact numerical values of the initial weights are not very
10 important, because of the feedback adjustment mechanism employed. Similarly, in alternate embodiments, other equations may be employed to quantitatively influence the weight adjustments (which in turn influences the probability of an advertisement getting selected), based on the actual impression presentation experience.

Upon determining the selection weight for the selected advertisement,
15 manager **120** further determines if there are additional advertisements remain to be processed, block **506**. If there are additional advertisements that remain to be processed, the process continues back at block **502**. Otherwise, manager **120** normalizes the newly determined weights, and terminates the process. In one embodiment, the newly determined weights are normalized back to the weight
20 range, e.g. 0 – 255 for the earlier mentioned 1 – 255 initial weight range.

Probabilistic Advertisement Selection and Determining Governing Presentation Parameters

Recall again from earlier description that in one embodiment, transaction
25 engines **114** probabilistically select advertisements for client devices **102**. **Figures 6-7** illustrate a process for making the probabilistic selection, in accordance with one embodiment. The embodiment is a multi-stage embodiment involving at least a first stage where the transaction engine first determines a pool of advertisement candidates, and then probabilistically selects the ultimate advertisements from the
30 candidate pool.

5 Skipping to **Figure 7**, wherein a more detailed process for probabilistically selecting n advertisements from a pool of M eligible advertisements is illustrated, in accordance with one embodiment. As illustrated, first, a transaction engine determines if n is greater than or equal to M , block **702**. If n is greater than or equal to M , the entire pool is selected, block **704**. If n is less than M , the transaction engine
10 next creates a working array holding the current selection weights of the eligible advertisements, block **706**. The transaction engine then sums the selection weights yield sum S , block **708**. Then, the transaction engine generates a random number r , that is between the values of 1 through S , block **710**, and uses r to select the advertisement, blocks **712-714**. The transaction engine selects the advertisement
15 by traversing the working array, and decrementing r with the weight of each advertisement it traversed. For the illustrated embodiment, the advertisement where r is decremented to zero or less than zero, is selected. Further, the weight of the selected item in the working array is set to zero. [As a result, the advertisement will not be selected in the next pass. Further, S will be automatically decremented for
20 the next pass.]

 So, upon selecting one advertisement, the transaction engine determines if additional advertisements are to be selected (i.e. whether the number of selected advertisements is still less than n), block **716**. If so, the process continues back at block **708**, otherwise the selection process is completed.

25 As described earlier, in one embodiment, each of the selected advertisements are advantageously provided to the requesting client devices with governing presentation parameters. In one embodiment, the governing presentation parameters include a minimum and a maximum parameter. The minimum parameter specifies the minimum number of times the selected advertisement is to
30 be presented, whereas the maximum parameter specifies the maximum number of times the selected advertisement is to be presented. The minimum and maximum

- 5 parameters are determined in accordance with the desired minimum and maximum impressions per user of the desired flight profile, and the duration of the flight profile. For example, if an advertisement campaign desires a minimum of 5 and a maximum of 20 impressions per user, for a campaign of 6 weeks and a total of 600 impressions, the minimum and maximum presentation parameters may be set and
- 10 increased over the campaign period as follows (for a constant delivery rate, a decreasing delivery rate or an increasing delivery rate):

Constant Rate

week	change in impressions	total impressions	rate	client min	client max
1	100	100	100	1	4
2	100	200	100	2	7
3	100	300	100	3	10
4	100	400	100	4	14
5	100	500	100	5	17
6	100	600	100	5	20

Decreasing Rate

week	impressions	total impressions	rate	client min	client max
1	300	300	300	3	10
2	125	425	125	4	15
3	75	500	75	5	17
4	50	550	50	5	19
5	25	575	25	5	20
6	25	600	25	5	20

Increasing Rate

week	impressions	total impressions	rate	client min	client max
1	25	25	25	1	1
2	25	50	25	1	2
3	50	100	50	1	4
4	75	150	50	2	5
5	150	300	150	3	10
6	300	600	300	5	20

Receiving and Aggregating Reported Presentations

Referring now back to **Fig. 6**, if it is determined back at block **602** by a transaction engine that a “request” for advertisements has not been received, the transaction engine further determines if it has received a report of an advertisement presentation, block **610**. If the determination is affirmative, the transaction engine logs the reported presentation, block **612**. Otherwise, the process continues back at block **602**. In one embodiment, the reported presentation is logged into a temporary log file (which as described earlier, is periodically transferred to logging service **116** for aggregation).

However, if it is determined back at block **612** that a report of an advertisement presentation has not been received, the transaction engine further determines if it is time to transfer the logged data to logging service **116**, block **614**.

5 If the determination is affirmative, the transaction engine transfers the logged data to logging service **116**, block **616**. Otherwise, the process continues back at block **602**.

However, if it is determined back at block **614** that it is not time to transfer the logged data to logging service **116**, the transaction engine further determines if it is time to update the selection weights it employs in making the advertisement
10 selections, block **616**. If the determination is affirmative, the transaction engine contacts manager **120** to obtain the most current set of selection weights to be employed for the probabilistic advertisement selection, block **618**. Either way, the process continues back at block **602**.

In alternate embodiments, the reporting may be made to other separate
15 and/or dedicated reporting receiving components/services instead (as opposed to the transaction engines.)

Logging Service

As described earlier, logging service **116** is employed to receive from
20 transaction engines **114** periodically the logged presentations of the various advertisements, as reported to transaction engines **114** by client devices **102**. **Figure 8** illustrates a process for aggregating the reported presentations, in accordance with one embodiment. As illustrated, when it is time to perform the aggregation, logging service **116** selects a log file transferred by one of the
25 transaction engines, block **802**. Next, logging service **116** processes the presentations logged, updating database **118** with the actual presentations made for the reported advertisements. Thereafter, logging service **116** determines if additional log files are to be processed, block **806**. If there are, the process returns to block **802**, otherwise the process terminates.

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Client Operation – Ad Management Extension

5 As described earlier, client devices **102** are equipped with generic agents, such as browsers **104**, enhanced with advertisement management extensions (AME) **106**. AMEs **106** incorporated with the teachings of the present invention interact with ad server **112** to facilitate advertisements to be presented to users of client devices **102** in accordance with desired flight profiles of the advertisers.

10 **Figures 9-11** illustrate the operation flow of the relevant aspects of AME **106** of **Fig. 1**, including the organization of local cache **108**, and associated working data structures, in accordance with one embodiment. More specifically, **Fig. 9** illustrates local cache **108** in more detail. As illustrated, local cache **108** includes directory **904** for storing control information associated with the “provided” advertisements. For
15 the embodiment, only control information including the location information of the advertisements are provided, the advertisements themselves are not “provided” initially. The control information for each advertisement includes in particular, an identifier (Ad id) for identifying the advertisement, a valid bit indicating whether the advertisement is eligible for selection for presentation, a location identifier (e.g. an
20 URL) pointing to the remote storage location where the advertisement may be retrieved, a minimum counter (min) denoting the minimum number of impressions the advertisement is to be presented to the user of the client device, a maximum counter (max) denoting the maximum number of impressions the advertisement is to be presented to the user of the client device, and an actual counter (count) denoting
25 the actual number of impressions the advertisement has been presented to the user of the client device. Further, as illustrated, for efficiency of operation, AME **106** also maintains a persistent valid counter **902** denoting the total number of valid (i.e. eligible) advertisements held in local cache **108**. Additionally, upon retrieval, local cache **108** is also used to locally cache the retrieved advertisement. [Recall from
30 earlier description, in alternate embodiments, the retrieved advertisements may be cached in the browser’s temporary file storage or other stores.]

5 For efficiency of operation, AME **106** employs a number of working queues to facilitate presentations of the provided advertisements to its user. **Figure 10** illustrates the working queues in further detail, in accordance with one embodiment. As illustrated, at least two queues, referred to as active and passive queues **1002** and **1004** are employed for each media type of advertisements. Media types are
10 banner, audio, video and so forth. Each active queue **1002** is employed to store the identifiers of advertisements (of the particular media type) provided in response to search activities of client device **102**, whereas each passive queue **1004** is employed to store the identifiers of both previously received advertisements and pre-provided advertisements (of the particular media type) to be presented to the user of
15 client device **102**.

For the illustrated embodiment, AME **106** systematically processes the queues (of the different media types) and present the queued advertisements. In one embodiment, for each media type, AME **106** first processes the queued entries of active queue **1002** one time through then moves all ads in the active queue to the
20 passive queue. Once the active queue is processed, the extension then processes ads in the passive queue in a round robin fashion, **1002**. In alternate embodiments, other “play” algorithms, e.g. ones that favor queued advertisements with below minimum counts over those with above minimum counts, may be employed instead.

Figure 11 illustrates the operational flow of the relevant aspects of
25 advertisement management extension **106**, in accordance with one embodiment. As illustrated, upon invocation, advertisement management extension (AME) **106** first fills passive queues **1104** with selected ones of advertisements “stored” in local cache **108**, block **1102**. In one embodiment, AME **106** selects the advertisements randomly. In alternate embodiments, AME **106** may select the advertisements using
30 a weighted approach similar to the transaction engines **114**. Thereafter, AME **106**

5 systematically presents the queued advertisements, block **1104**. [Since active queues **1104** queues the advertisements provided in response to search activities, these queues are “empty” initially.] For the illustrated embodiment, AME **106** also reports each presentation in real time to a transaction engine of ad server **112**. Alternative embodiments can batch report collections of presentations to a
 10 transaction engine in order to reduce transaction overhead. Further, AME **106** updates the actual presentation count of the advertisement, block **1106**.

Upon updating, AME **106** determines if the maximum number of presentations has been reached, block **1108**. If so, AME **106** updates the control information in local cache **108**, in particular, “invalidating” the advertisement whose
 15 maximum presentation has been reached, block **1110**. In replacement of the advertisement becoming ineligible, AME **106** selects another advertisement from local cache **108** to replace the advertisement that became ineligible, block **1112**.

For the illustrated embodiment, AME **106** further determines if the number of valid advertisements remain stored in local cache **108** has dropped below a
 20 predetermined threshold. If so, AME **106** requests ad server **112** (through a dynamically assigned transaction server **114**) for additional advertisements to replenish the depleted advertisements, **1116**.

Thereafter, whether having made the replenishment request, or whether it was earlier decided that the maximum number of impressions has not been reached
 25 at block **1108**, AME **106** determines if new advertisements are being provided by ad server **112**, block **1118**. The new advertisements may be provided in response to an explicit request as early described in connection with block **1116**, or as earlier described in response to a search being conducted by a user of the client device. If no advertisements are being provided, the process continues back at block **1104**.

5 However, if advertisements are being provided, AME **106** accepts the advertisements and processes them for storage into local cache **108**. The processing includes in particular, whether an advertisement has been previously provided, and if so whether the maximum count has already been reached. If an advertisement is a new advertisement not in the local cache, a new record is made,
10 and the advertisement is stored. If it is an existing advertisement, a check of the min-max parameters is made to determine if the advertisement remain or may become eligible again. Further, a check is made to see if the advertisement is provided in association with a search being conducted. If so, the advertisement is immediately included (in the front of the appropriate active queue) as one of the
15 queued advertisement, replacing an existing queued advertisement if necessary. In other words, the present invention is advantageously able to efficiently prevent the flight profiles from being substantially satisfied by a small group of users.

 In one embodiment, advertisements having been presented a number of times close to the specified maximum parameter are selected to make room in the queues, if necessary. Similarly, a least recently used (LRU) like approach is used to
20 make room in local cache **106** if necessary (e.g. when all stored advertisements are still valid; in other words, none has reached the maximum count). Obviously, all associated control data, such as the number of valid advertisements, and so forth, are timely updated accordingly. Thereafter, the process continues back at block
25 **1304**.

 Accordingly, AME **106** is able to collaborate with ad server **112** to facilitate achievement of the desired flight profiles of the advertisements.

Figure 12 illustrates an example computer system suitable for use as an implementing data processing server of ad server **112** or as a client device **102**, in accordance with one embodiment. As shown, computer system **1200** includes one or more processors **1202** and system memory **1204**. Additionally, computer system **1200** includes mass storage devices **1206** (such as diskette, hard drive, CDROM and so forth), input/output devices **1208** (such as keyboard, cursor control and so forth) and communication interfaces **1210** (such as network interface cards, modems and so forth). The elements are coupled to each other via system bus **1212**, which represents one or more buses. In the case of multiple buses, they are bridged by one or more bus bridges (not shown). Each of these elements performs its conventional functions known in the art. In particular, system memory **1204** and mass storage **1206** are employed to store a working copy and a permanent copy of the programming instructions implementing one or more of the components of ad server **112** or advertising management extension **106** of the present invention. The permanent copy of the programming instructions of advertising management extension **106** may e.g. be downloaded into mass storage **1206** through communication interface **1210**. The constitution of these elements **1202-1212** are known, and accordingly will not be further described.

Thus, it can be seen from the above descriptions, a novel method and apparatus for a distributed approach to managing advertisement presentations per desired flight profiles has been described. The novel method/apparatus is advantageously scalable to support a very large number of client computers.

While the present invention has been described in terms of the above illustrated embodiments, those skilled in the art will recognize that the invention is not

- 5 limited to the embodiments described. The present invention can be practiced with modification and alteration within the spirit and scope of the appended claims. The description is thus to be regarded as illustrative instead of restrictive on the present invention.
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